Geophysical Research Abstracts
Vol. 16, EGU2014-10448-1, 2014
EGU General Assembly 2014

A comparison of small, affordable seismic sources at the Ketzin CO_2 storage site, Germany

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Seismic methods have proven to be effective for monitoring the movement and location of injected CO_2 within deep saline aquifers. However, a disadvantage of seismic monitoring is the high costs associated with many repeat seismic surveys as part of a long term monitoring strategy of a CO_2 storage site. As the cost for the use of the seismic source is often a significant part of the overall survey cost, affordable, smaller sources would increase the potential feasibility of a long term seismic monitoring strategy.

A comparison of three land seismic sources is performed at the Ketzin CO_2 storage site, Germany. Two of these sources (Vibsist 500 and Bobcat drop hammer) can be considered to be smaller and more affordable sources than those conventionally used in the seismic monitor surveys at Ketzin. In this study these smaller sources are compared to a larger more conventional Vibsist 3000 source. The subsurface target for the three sources in this comparison is the CO_2 storage reservoir for the Ketzin site, located within the Triassic Stuttgart formation, which lies at a depth of approximately 600m/500ms. Two of the sources are Swept Impact (SIST) type courses (Vibsist 500 and 3000) which use hydraulic concrete breaking hammers. The third source uses a concrete breaking drop hammer tool mounted on a Bobcat loader. Data were collected along a 984m long profile with 24m receiver spacing and 12m shot spacing in 2011, 2012 and 2013 using the three different sources. A quantitative and qualitative comparison of the raw data from the three sources was performed in order to assess their relative performance. Frequency content, signal to noise ratio and penetration depth curves were calculated for the raw data. Data from the three sources was also processed using a conventional workflow to produce stacked sections which were compared.

Based on the results from this study the Bobcat drop hammer source appears to perform better than the Vibsist 500 source. However both of the smaller sources were capable of producing good images of the target CO_2 storage reservoir. Hence, both provide viable options as small affordable seismic sources for long term monitoring at the Ketzin site, or other shallow CO_2 storage sites.